Limiting visual stellar magnitudes

Study time: 1 hour

Summary

In this observational activity you will investigate the limiting visual stellar magnitude at your chosen observing site, preferably in a variety of atmospheric conditions. (As an 'optional extra', you can compare two different sites.) This will be performed by visual observations of stars in the constellation of Orion.

You should do this activity after you have completed 'In and around Orion', although both of these activities can be done during the same observing session.

The study time indicates how long you will need for the observing session(s) and includes preparation and note taking; the observations themselves should take less time. Data analysis and writing up require additional time after the observing session.

Learning outcomes

The learning outcomes for the observational activities are grouped together at the front of the *Observational activities* booklet.

Introduction

The limiting visual stellar magnitude, $\hat{V}$, is the apparent visual magnitude, V (see Section 3.3.3 in *An Introduction to the Sun and Stars*), of the faintest star that you can see with the unaided eye. It helps define the quality of a site for astronomical observations. This limit is determined by three things:

1 Atmospheric extinction. This is the reduction in light reaching you from a star as a result of absorption and scattering in the atmosphere. Normally, the greater the altitude of the star, the less the degree of extinction.

2 Light pollution. This is light, usually from ground level, scattered back downwards by small solid and liquid particles in the atmosphere. Again, the greater the star's altitude, then, normally, the less the light pollution.

3 Your eyes! We do differ from each other in our ability to detect faint stars. Moreover, a person's left and right eyes are likely to differ. Do use your better eye.

Note that light pollution and atmospheric extinction vary from site to site, with the weather, and with the level of any human activity that generates solid and liquid particles, e.g. transport, industrial processes.

Preparation

Try to be on site when Orion is near its maximum altitude, that is within two hours of it crossing/having crossed the meridian – use your planisphere *before* you set off, to decide whether Orion will meet this condition when you are on site. Avoid making observations when the Moon is up, unless it is only a thin crescent at low altitude: you need conditions to be as dark as possible.

When you go to your observing site to do this activity, you will need to take:

- these activity notes
- a torch (flashlight)
- your activity notebook, plus something to write with.

Observations

We suggest that you estimate $\hat{V}$ in Orion, in each of the two regions of the sky marked A and B in Figure 1 (*overleaf*), which shows stars down to $V = 6$, about the limit for human vision at a *good* site in *good* conditions. Before you make each estimate of $\hat{V}$, allow your eyes at least 5 minutes to become adapted to the (low) light conditions under which you will make your estimate.

1 For region A, near Betelgeuse, use Figure 1 to estimate $\hat{V}$. Estimate also the uncertainty in $\hat{V}$. Obtain the corresponding estimates for region B, near Rigel. Record both values and the uncertainties in your activity notebook, along with the approximate altitude of each region, the date and time, details of the site, and details of atmospheric conditions and light pollution. Record any other pertinent observations.

   Note: in estimating $\hat{V}$, you might notice the benefit of averted vision (see Section 2.4 in the *Observational activities* booklet). Indeed, the above-mentioned limit of $V = 6$ normally requires averted vision. Try to obtain your estimates of $\hat{V}$ by using averted vision. Record whether you do use averted vision.

2 Repeat step 1 on at least one other occasion, when atmospheric conditions or light pollution are different.

3 You can also repeat the project at a different site, though this is very much an 'optional extra'.

After you have made your estimates of $\hat{V}$, write some brief comments about the quality of the site under the various atmospheric conditions, and the degree of light pollution.

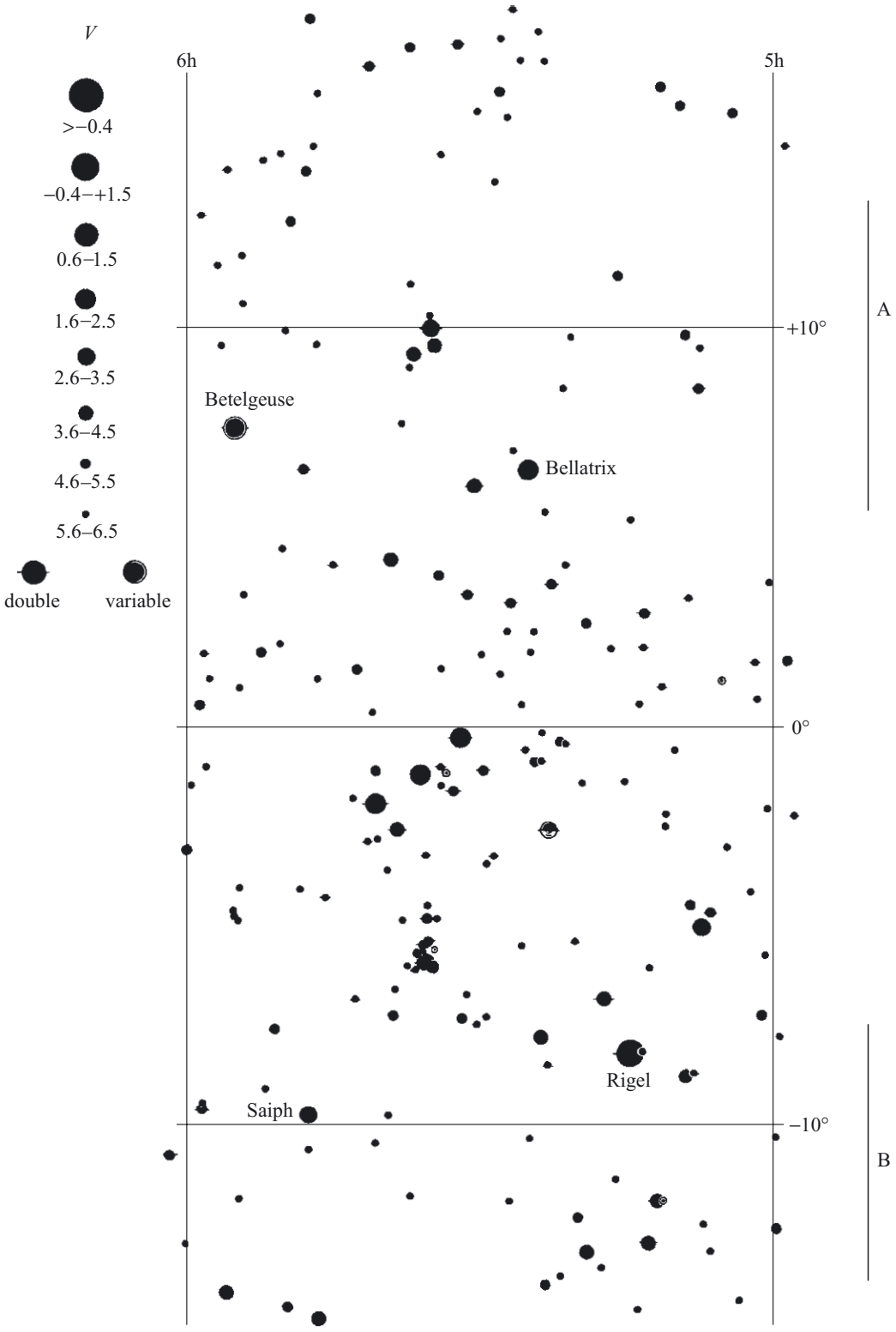

Figure 1 Stars in Orion, down to $V = 6$.